Name _____ Student Lab Booklet

WATER POLLUTION

1. This program concerns the effects of water pollution on aquatic life. To begin, run the INTRODUCTION for an explanation of the factors that affect water quality.

2. The EXPERIMENTAL MODE section allows you to set up simulated experiments on the computer. You can investigate the effects of changing these variables:

   A) Body of water
   (pond, lake, slow/fast river)

   B) Temperature
   (1°-32° C)

   C) Type of pollution
   (industrial, sewage)

   D) Dumping rate
   (0-14 ppm/day)

   E) Type of treatment
   (none, primary, secondary)

   F) Number of days
   (2-30)

Activity 1

The Ketone Chemical plant is situated on a slow river whose year-round temperature remains about 18° C. The plant dumps untreated industrial waste into the river at an average rate of 12 parts per million (ppm) per day. Run this experiment for 30 days to determine:

A) What happens to the concentration of waste over time?

B) On what day does the waste concentration start to level off?

C) What happens to the concentration of dissolved oxygen over time?

D) Does a fishkill occur? _____ If so, when? _____ Why?

E) Compare the pollution discharged by the chemical plant to that of a town dumping 12 ppm/day of untreated sewage into the same river. Which type of waste reduces the dissolved O_2 most rapidly?

Which pollutant is decomposed to a greater extent? _____ Why?

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Activity 2

The Flexy-Plastic Company is investigating four possible sites for a new plant: along a 14° C fast-flowing river; along a 14° C slow-flowing river; on a 14° C quiet lake; on a 14° C pond. Flexy-Plastic will dispose of an average of 12 ppm/day of untreated industrial waste directly into the water.

A) How many days does it take for the dissolved O_2 level to fall below 5 ppm for:

fast river _____ slow river _____ lake _____ pond _____

B) Which body of water retains the highest levels of dissolved O_2 for the longest period of time? _____ Why?

C) Which plant location would be the least damaging to the environment? _____ Why?

D) List two measures the company can take to prevent a fishkill while the plant is in operation.

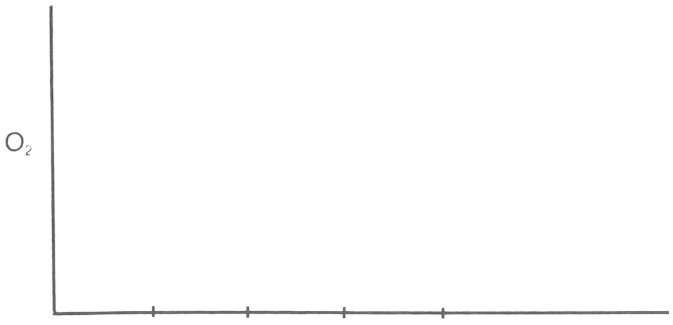
1) _____ 2) _____

E) Does decomposition of the plant's waste continue after the dissolved O_2 level drops to zero? _____ Explain your answer.

Activity 3

Average seasonal temperatures of Peach Lake are:

Winter 1° C, Spring 11° C, Summer 26° C, Fall 16° C.



A) Graph the seasonal temperature vs dissolved O_2.

B) Describe the relation between dissolved O_2 and water temperature.

C) Which season would you choose to dump 10 ppm/day of untreated industrial waste to cause the least environmental damage? _____

D) Describe the interactions between water temperature, dissolved O_2 and waste decomposition.

Activity 4

Testing the industrial waste discharge of Slick Oil Refinery for 5 days shows 12 ppm/day entering the 18° C waters of a slow river.

A) Will a fishkill occur? _____ If so, predict which day _____

B) Is water treatment necessary to protect the fish life? _____
If so, which treatment?

Activity 5

Bacteria and fungi use dissolved O_2 to decompose organic pollutants. The amount of O_2 needed by these decomposers is called Biochemical Oxygen Demand (BOD). The Department of Fish & Game wants to stock fish in several fast rivers. These fish cannot tolerate a dissolved oxygen level of less than 5 ppm.

Blue River receives 8 ppm/day of secondary treated sewage. It maintains a year-round temperature of 10° C.

Tepid River receives 3 ppm/day of primary treated industrial waste. It maintains a year-round temperature of 22° C.

Narrow River receives 6 ppm/day of untreated sewage. It has a year-round temperature of 21° C.

A) Which river has the highest BOD values?

B) Which river maintains the lowest concentration of waste?

C) Which rivers can be stocked with fish?

Advanced Activities

1. A paper mill on Sedge Pond dumps 14 ppm/day of untreated waste directly into the 10° C pond causing a fishkill. The County is requiring the mill either to close (putting many people out of work) or to change its waste discharge so the levels of dissolved O_2 in the pond do not fall below 5 ppm. What measures can management take to meet the County's requirements? Will the mill have to close?

2. A sewage plant situated on a slow river with a temperature of 7° C produces 12 ppm/day of waste that is given primary treatment. Downriver, a dam regulating the rate at which water enters a 15° C pond reduces the concentration of this waste to 2 ppm/day by secondary treatment.

   A) Which body of water has the higher BOD?

   B) Which of these environments can support a game fish population that requires a minimum of 5 ppm of dissolved O_2?

   C) If the dam were removed, the pond would receive the full 12 ppm/day of untreated sewage. What would be the effect on the pond's dissolved O_2 levels if this occurred?

GLOSSARY

Biochemical Oxygen Demand (BOD): the amount of oxygen required to decompose the organic waste content of a body of water.

Decomposition: the biochemical breakdown of organic materials into stable, inorganic compounds by bacteria and fungi. This process may be done aerobically (with oxygen) or anaerobically (without oxygen).

Fishkill: less than 5 ppm of dissolved oxygen at 10° C (50° F) results in the death of large numbers of game fish such as trout.

Industrial waste: from factories, mines, research facilities, etc.; includes salts, acids, oils, tars, greases and heavy metals.

Pollution: the undesirable alteration of the environment through human activities.

Primary Waste Treatment: removes heavy, solid waste materials through filtering; this process reduces the BOD by 35-40%.

Secondary Waste Treatment: destroys harmful microorganisms and removes certain dissolved materials by means of bacterial action. Reduces BOD by 80-90% when coupled with primary waste treatment.

Sewage: organic plant, animal, and human wastes.

Sludge: semiliquid waste resulting from sewage purification.

Solubility: the ability to dissolve.